

PATENT COOPERATION TREATY

PCT


INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

REC'D 16 NOV 2005

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Applicant's or agent's file reference LU6133A		FOR FURTHER ACTION		See Form PCT/PEA/416
International application No. PCT/EP2004/010376		International filing date (day/month/year) 16.09.2004		Priority date (day/month/year) 24.09.2003
International Patent Classification (IPC) or national classification and IPC B01J19/18, C08F2/01				
Applicant BASELL POLYOLEFINE GMBH et al.				
<p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 8 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input checked="" type="checkbox"/> sent to the applicant and to the International Bureau a total of 1 sheets, as follows:</p> <p><input checked="" type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p><input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</p> <p>b. <input type="checkbox"/> (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p>				
<p>4. This report contains indications relating to the following items:</p> <p><input checked="" type="checkbox"/> Box No. I Basis of the opinion</p> <p><input type="checkbox"/> Box No. II Priority</p> <p><input checked="" type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p><input type="checkbox"/> Box No. IV Lack of unity of invention</p> <p><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p><input checked="" type="checkbox"/> Box No. VI Certain documents cited</p> <p><input type="checkbox"/> Box No. VII Certain defects in the international application</p> <p><input checked="" type="checkbox"/> Box No. VIII Certain observations on the international application</p>				
Date of submission of the demand 08.07.2005		Date of completion of this report 15.11.2005		
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465		Authorized Officer Thomasson, P Telephone No. +49 89 2399-8339		

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**INTERNATIONAL PRELIMINARY REPORT
ON PATENTABILITY**

International application No.
PCT/EP2004/010376

Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
- ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
- ☐ international search (under Rules 12.3 and 23.1(b))
 - ☐ publication of the international application (under Rule 12.4)
 - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

Description, Pages

1-11

as originally filed

Claims, Numbers

1-7

received on 12.07.2005 with letter of 24.06.2005

- ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing
3. ☐ The amendments have resulted in the cancellation of:
- ☐ the description, pages
 - ☐ the claims, Nos.
 - ☐ the drawings, sheets/figs
 - ☐ the sequence listing (*specify*):
 - ☐ any table(s) related to sequence listing (*specify*):
4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
- ☐ the description, pages
 - ☐ the claims, Nos.
 - ☐ the drawings, sheets/figs
 - ☐ the sequence listing (*specify*):
 - ☐ any table(s) related to sequence listing (*specify*):

* If item 4 applies, some or all of these sheets may be marked "superseded."

**INTERNATIONAL PRELIMINARY REPORT
ON PATENTABILITY**

International application No.
PCT/EP2004/010376

Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

1. The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non-obvious), or to be industrially applicable have not been examined in respect of:

☐ the entire international application,

☒ claims Nos. 1

because:

☐ the said international application, or the said claims Nos. relate to the following subject matter which does not require an international preliminary examination (specify):

☐ the description, claims or drawings (*indicate particular elements below*) or said claims Nos. are so unclear that no meaningful opinion could be formed (*specify*):

☐ the claims, or said claims Nos. are so inadequately supported by the description that no meaningful opinion could be formed.

☒ no international search report has been established for the said claims Nos. 1

☐ the nucleotide and/or amino acid sequence listing does not comply with the standard provided for in Annex C of the Administrative Instructions in that:

the written form

☐ has not been furnished

☐ does not comply with the standard

the computer readable form

☐ has not been furnished

☐ does not comply with the standard

☐ the tables related to the nucleotide and/or amino acid sequence listing, if in computer readable form only, do not comply with the technical requirements provided for in Annex C-*bis* of the Administrative Instructions.

☐ See separate sheet for further details

**INTERNATIONAL PRELIMINARY REPORT
ON PATENTABILITY**

International application No.
PCT/EP2004/010376

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	2-8
	No: Claims	
Inventive step (IS)	Yes: Claims	2-8
	No: Claims	
Industrial applicability (IA)	Yes: Claims	2-8
	No: Claims	

2. Citations and explanations (Rule 70.7):

see separate sheet

Box No. VI Certain documents cited

1. Certain published documents (Rule 70.10)

and / or

2. Non-written disclosures (Rule 70.9)

see separate sheet

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability;
citations and explanations supporting such statement

1. Reference is made to the following documents:

D1: GB-A-1 482 148 (MONTEDISON SPA) 3 August 1977 (1977-08-03)
D2: DE 905 547 C (BATAAFSCHE PETROLEUM) 4 March 1954 (1954-03-04)

2. The present application meets the requirement of Article 33(2)-(3) PCT for the following reasons:

- 2.1 Closest prior art

D1 discloses a process for polymerization in a loop reactor of at least one olefinic monomer, e. g. **ethylene, propylene, 1-butene** (see D1: page 1, lines 36-51). The attention of the applicant is drawn to the fact that the wording of claim 1 "a process for polymerizing at least one olefinic monomer selected from the group comprising ethylene, propylene, 1-butene" does not exclude that these monomers are **co-polymerized** with other monomers, e. g. some vinyl monomers, as this is the case in D1. This is also what the applicant intends to do (see the description of the present application on page 4, lines 15-22 and on page 4, line 36 - page 5, line 3). The polymerization according to D1 may be carried out in suspension and may include solid products within the reaction mixture (see D1: page 1, lines 80-83 and page 3, lines 76-91). The process according to D1 is carried out at temperatures between 20 to 150°C and at pressures between **5 to 100 bar** (see D1: International Search Report). In one example the pressure is 40 kg/sq.cm (gauge) which represents 40,2 bar (see D1: page 3, lines 34-36).

The loop reactor of D1 comprises a cyclic reactor tube with at least one widening and narrowing in a region other than that of the axial pump (see D1: figure 1; different diameters of the horizontal and vertical legs). Although not explicitly disclosed in D1 it is clear, with regard to the drawings, that the diameter variation of the cyclic reactor tube is of at least 10 %. Furthermore some **polymerization catalysts** may be used in the process of D1 (see D1: page 1, lines 66-74 and page 2, lines 3-7).

2.2 Novelty

The subject-matter of claim 2 differs from D1 in that it indicates a **combination** of the following features (1) a pressure of from 43 to 80 bar, (2) polymerization carried out with a catalyst, (3) an ethylene concentration of at least 10 mol%, and (4) the polymer formed is present in a suspension.

2.3 Inventive step

The technical problem to be solved against D1 is to improve the polymerization capacity of a suspension polymerization reactor. The applicant found that the combination of the features (1)-(4) listed above (see § 2.2) allows to reach higher average solids concentration of polymers than the prior art. The subject-matter of claim 2 allows an average solids concentration of more than 53 % by weight (continuous discharge) or more than 45 % by weight (discontinuous discharge). D1 does not disclose any average solids concentration of polymers. D2, which discloses an olefins polymerization process, discloses an highest average solids concentration of polymers of 20 % (see D2: page 3, lines 25-32). The applicant indicates in the present application on page 1, line 32 - page 2, line 4, that the prior art can not achieve polymer solids concentrations of more than 37-40 % by weight in suspension polymerization processes. It is plausible that features (1)-(4), especially the variation of diameter of the loop reactor and the pressure between 43-80 bars, allow to reach some higher polymer solids concentrations and therefore to solve the above technical problem (see the present application on page 3, lines 18-28, on page 4, line 29 - page 5, line 10). Therefore the inventive step of claims 2-8 can be recognized.

Re Item VI

Certain documents cited

Certain published documents

Application No Patent No	Publication date (day/month/year)	Filing date (day/month/year)	Priority date (valid claim) (day/month/year)
WO2004/026463	01/04/2004	23/09/2003	23/09/2002

Re Item VIII

Certain observations on the international application

1. The present application does not meet the requirements of Article 6 PCT:
 - 1.1 Claim 1 indicates a process defined by reference to a desirable characteristic, namely an average solids concentration of more than 53 % by weight (continuous discharge) or more than 45 % by weight (discontinuous discharge). Claim 1 lacks clarity (Article 6 PCT). An attempt is made to define the process by reference to a **result to be achieved**. To this regard it is explicitly stated in the description of the present application on page 2, lines 5-10 that "It is an object of the present invention to find a process...which process makes higher solids concentration in the reactor...possible". This supports clearly that the features of an average solids concentration of more than 53 % by weight (continuous discharge) or more than 45 % by weight (discontinuous discharge) correspond to a **result to be achieved**. This is confirmed by the statement of the description on page 4, lines 29-32 which states that "The present invention makes it possible to carry out a suspension polymerization process...at solids concentrations of more than 53 % by weight".
Furthermore the concentrations of solids and of ethylene indicated in claim 1 are achieved by only a limited number of methods, namely **those using a loop reactor whose diameter varies by at least 10% and in which there is at least one widening and narrowing** (see the description on page 2, lines 18-26; page 4, line 34 - page 5, line 17). Although it is stated in the description on page 4, line 34 that the above features correspond to "one embodiment" of the present invention, no other embodiment is disclosed. It is furthermore explicitly stated on page 4, line 39 - page 5, line 3, that "the invention is based...deliberate nonuniform flow of the polymerization mixture...makes it possible to increase the solids concentration in the reactor". The only way disclosed in the application in order to deliver a nonuniform flow of the polymerization mixture is to use a loop reactor whose diameter varies by at least 10% and in which there is at least one widening and narrowing.

**INTERNATIONAL PRELIMINARY
REPORT ON PATENTABILITY
(SEPARATE SHEET)**

International application No.

PCT/EP2004/010376

- 1.2 Claim 1 indicates a process for polymerization of at least one olefinic monomer **selected from** ethylene, propylene and 1-butene (ethylene is only optional and not compulsory). Furthermore claim 1 indicates that the ethylene concentration is of at least 10 mol%, which makes the presence of ethylene as being compulsory. Therefore claim 1 lacks clarity.

Additional observations:

Claim 1, line 14: "at a pressure of **from**" instead of "form".

We claim:

1. A process for polymerizing at least one olefinic monomer selected from ethylene, propylene, 1-butene in a loop reactor in the presence of a polymerization catalyst at from 20 to 150°C, but below the melting point of the polymer to be formed, and a pressure of from 5 to 100 bar, where the polymer formed is present in a suspension in a liquid or supercritical suspension medium and this suspension is circulated by means of an axial pump, wherein the polymerization is carried out at an average solids concentration in the reactor of more than 53% by weight, based on the total mass of the contents of the reactor, in the case of continuous product discharge and at an average solids concentration in the reactor of more than 45% by weight, based on the total mass of the contents of the reactor, in the case of discontinuous product discharge, and wherein the polymerization is carried out at an ethylene concentration of at least 10 mol%, based on the suspension medium, and the polymerization is carried out at pressure of from 43 to 80 bar.
2. A polymerization process as claimed in claim 1, wherein the loop reactor comprises a cyclic reactor tube whose diameter varies by at least 10%, based on the predominant reactor tube diameter, and in which there is at least one widening and narrowing in a region other than that of the axial pump.
3. A process as claimed in claim 1 or 2, wherein there is an additional widening and narrowing of the reactor tube in the region of the axial pump.
4. A process as claimed in any of the preceding claims, wherein ethylene is used as monomer and at least one α -olefin having from 3 to 8 carbon atoms is used as comonomer.
5. A process as claimed in any of the preceding claims, wherein at least one olefinic monomer is fed in at at least 2 points along the reactor tube.
6. A process as claimed in any of the preceding claims, wherein the polymer formed is discharged continuously from the reactor.
7. A process for polymerizing at least one olefinic monomer in a loop reactor as claimed in any of the preceding claims, wherein the polymerization in this loop reactor is preceded or followed by at least one further polymerization step in a loop reactor or a gas-phase reactor.